Woods Hole Oceanographic Institution

Deep-Sea Mining FAQs

What is deep-sea mining?

Deep-sea mining is the proposed extraction of metallic and non-metallic mineral resources from the ocean floor at water depths greater than 200 meters (650 feet). Shallow-water mining for sand, tin, and diamonds already occurs in some locations around the globe.

What types of minerals would be mined?

Nickel, copper, cobalt, manganese, zinc, silver, and gold are some of the metals that are targets of proposed mining activities. They can be found in different types of deep-sea mineral deposits: polymetallic (also called manganese) nodules which can be found on abyssal plains at water depths of about 3,000 to 6,000 meters (9,800 to 19,700 feet); cobalt-rich ferromanganese crusts, which tend to be found on seamounts at a wide range of water depths, but with economically viable deposits found at a range of about 800 to 2,500 meters (2,600 to 8,200 feet); and seafloor massive sulfides, which form at high-temperature hydrothermal vents at water depths of about 1,000 to 5,000 meters (3,300 to 16,400 feet). Non-metallic minerals include phosphate deposits, which tend to occur at shallower depths near continental margins.

How extensive are the mineral resources in the deep sea? What's their economic worth?

The full extent of mineral resources in the deep ocean is not known, as much of the seafloor remains unexplored. To quote a recent peer-reviewed publication, "At present, a proper assessment of these resources is not possible due to a severe lack of information … It is clear, however, that manganese nodules and cobalt-rich ferromanganese crusts are a vast resource and mining them could have a profound impact on global metal markets, whereas the global resource potential of seafloor massive sulfides appears to be small." (*Petersen et al. 2016 Marine Policy*)

How would they be extracted?

Many of the engineering challenges associated with working in the deep sea have already been identified and begun to be addressed by the offshore oil and gas industry. Different types of machines for mining seafloor nodules and sulfide deposits have been built and the components for mining systems are currently being tested in deep-sea deployments. Examples of machines made for deep-sea mining, which include auxiliary cutters, bulk cutters, and collecting machines that draw cut material up as seawater slurry, can be seen on the Nautilus Minerals website.

What are the expected environmental impacts of the mining process?
Environmental impacts of deep-sea mining are expected to include direct and indirect effects of vehicles and other mining installations on the seabed. Direct effects will include the loss of habitats and associated organisms during the cutting and extraction process, and indirect effects will include sediment plumes that may be vehicle-generated or the result of returning waste material to the seafloor, as well as noise, vibrations, and light pollution from mining machines. A discussion of physical impacts expected from deep-sea mining is available on the MIDAS website.

What effects might it have on deep-sea life?
Deep-sea mining may cause the destruction of local populations of animals. This could have wider-reaching impacts because seafloor communities may be part of a food web that includes animals living in the water column. Local populations are also part of a larger, meta-population of the same species, with individuals that disperse across a wide volume of ocean at an early life stage.
Sediment plumes from mining activities may bury or otherwise affect the feeding of animals that subsist on material suspended in the water, such as deep-sea corals. Ecosystem impacts in many of the targeted habitats are likely to be long lasting—longer than our lifetimes—as many of the potentially affected species are slow growing and long lived.

Where is deep-sea mining being proposed? When will it begin?
For manganese nodules, much of the mineral exploration has focused on the eastern Pacific, in a region known as the Clarion-Clipperton Zone. For ferromanganese crusts, much of the mineral exploration is in the western Pacific in a region known as the Prime Crust Zone. Both of these regions primarily encompass seafloor that is beyond national jurisdiction, and mining will not begin until regulations for the exploitation of mineral resources are finalized. Polymetallic sulfides are found along mid-ocean ridges also in the area beyond national jurisdiction, but can also be found at volcanic arcs and back-arc spreading centers within various national jurisdictions.

The first proposed deep-sea mining project, Solwara 1, is entirely within the

jurisdiction of Papua New Guinea and is scheduled to begin in 2019 (according to the Nautilus Minerals Investor Update, September 2016). Explore a map with recent sea-going expeditions associated with mineral exploration at the Deep Sea Mining Watch website.

Who regulates seafloor mining?

The International Seabed Authority (ISA), established under the United Nations Convention on the Law of the Sea, is the autonomous organization that controls mineral exploration and exploitation in the area beyond national jurisdiction. The first working draft of regulations for exploitation was open for public comment through November 2016. The first working draft for environmental regulations is expected in February 2017.

About 27 countries have already signed contracts with the ISA to explore for deep-sea resources. A current list is available on the organization's website.

The Woods Hole Oceanographic Institution is a private, non-profit organization on Cape Cod, Mass., dedicated to marine research, engineering, and higher education. Established in 1930 on a recommendation from the National Academy of Sciences, its primary mission is to understand the ocean and its interaction with the Earth as a whole, and to communicate a basic understanding of the ocean's role in the changing global environment. For more information, please visit www.whoi.edu.